Exothermic and Endothermic Processes

Chemical Reactions

- All chemical reactions involve bond breaking and bond forming

- Energy is absorbed when bonds break

EX: Breaking a pencil requires work (energy)

- Energy is released when bonds form

EX: Challenger

ENERGY

Chemical reactions are accompanied by a change in energy, commonly in the form of heat

Whether we see heat / sound / light as a product depends on whether it takes more energy to break the bonds or more energy is release when the bonds form

Law of Conservation of Energy

- The law of conservation of energy states that energy cannot be created or destroyed, but only changed from one form to another.

How do we define the system and the surroundings?

To understand energy changes, first we must define two things

-The system

-The surrounding

Photosynthesis :

$6CO_2 + 6H_2O$ (+ light energy) --→ $C_6H_{12}O_6 + 6O_2$

It takes more energy to break the bonds of the reactants than is released when the products are formed therefore the reaction is ENDOTHERMIC

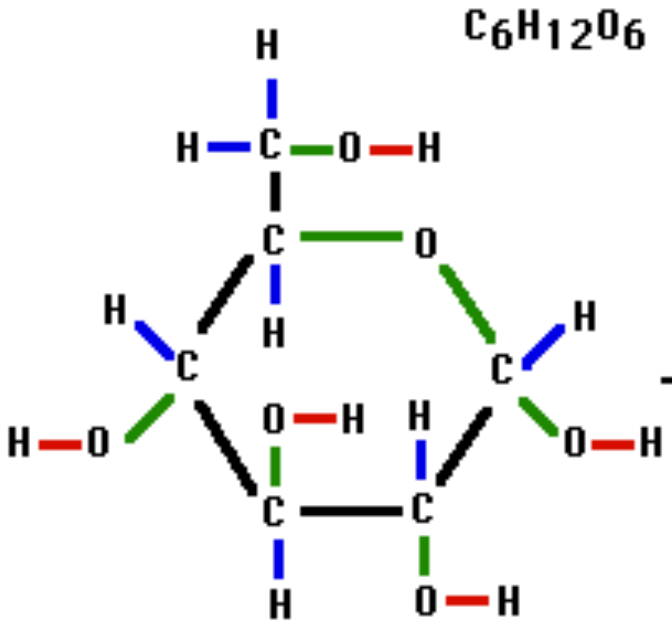
ENDOTHERMIC – energy (in the form of light) is being absorbed by the system, the plant --- leaving the surroundings, the air, feeling cooler

Cellular Respiration:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6\ H_2O$ (+ Heat energy)

It takes less energy to break the bonds of the reactants than is released when the products are formed therefore the reaction is EXOTHERMIC

EXOTHERMIC – energy in the form of heat is being released from the system, the cells of the body --- leaving the surroundings feeling warmer, the air around our bodies



$C_6H_{12}O_6 + 6O_2 \longleftrightarrow 6H_2O + 6CO_2$

Respiration

$\Delta G = -686$ kcal

$+ 6\,O{=}O^{116}$ $\rightarrow$ $6\,H{-}O{-}H + 6\,O{=}C{=}O^{187}$

Photosynthesis

$\Delta G = +686$ kcal

C-O	78 x 7	546
O-H	110 x 5	550
C-H	98 x 7	686
C-C	80 x 5	400

116 x 6 → 696

110 x2 x6 → 1320

187 x2 x6 → 2244

2182 + 696 → 2878 kcal

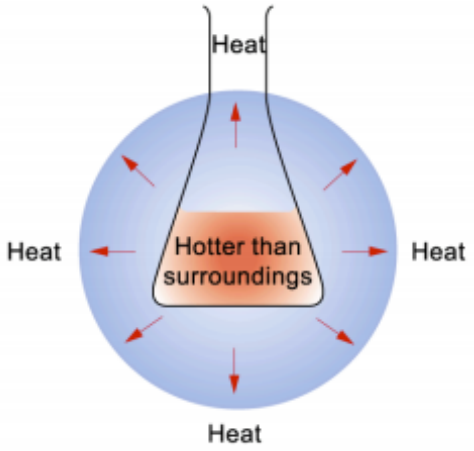
1320 + 2244 → 3564 kcal

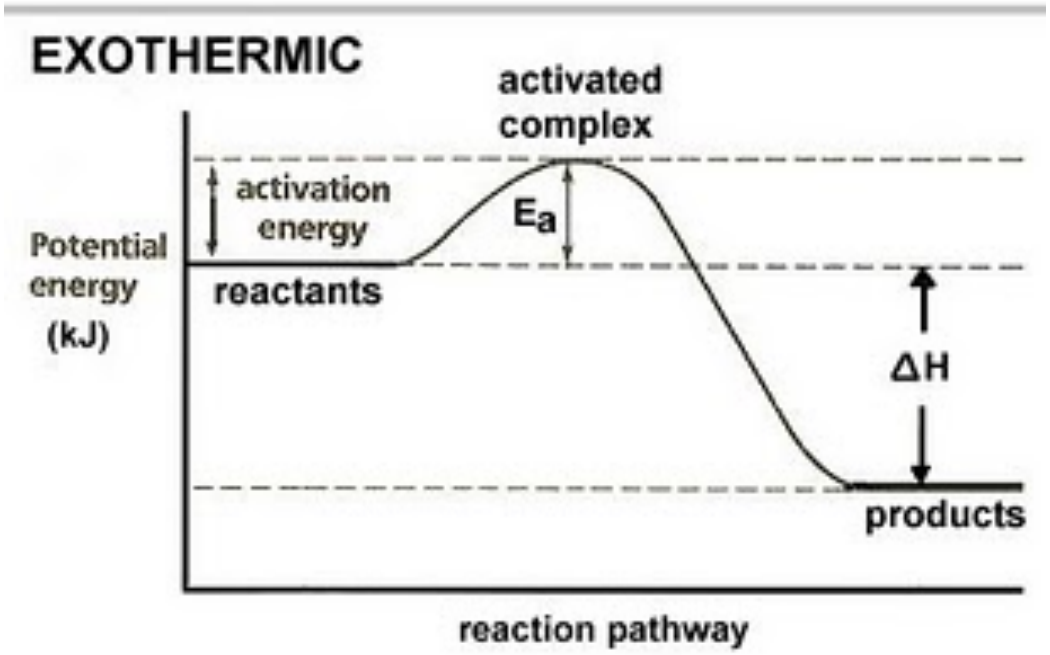
3564 - 2878 = 686

Exothermic Processes

A reaction in which heat energy is released by the system to the surroundings is exothermic.

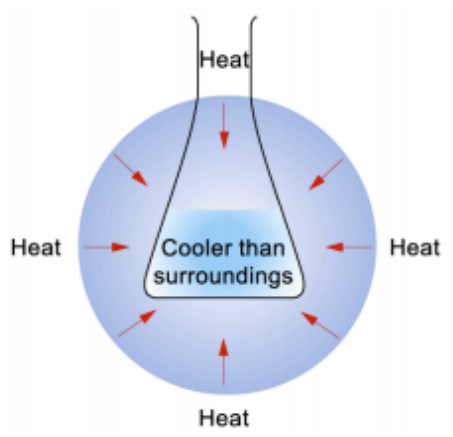
Energy IN < Energy OUT

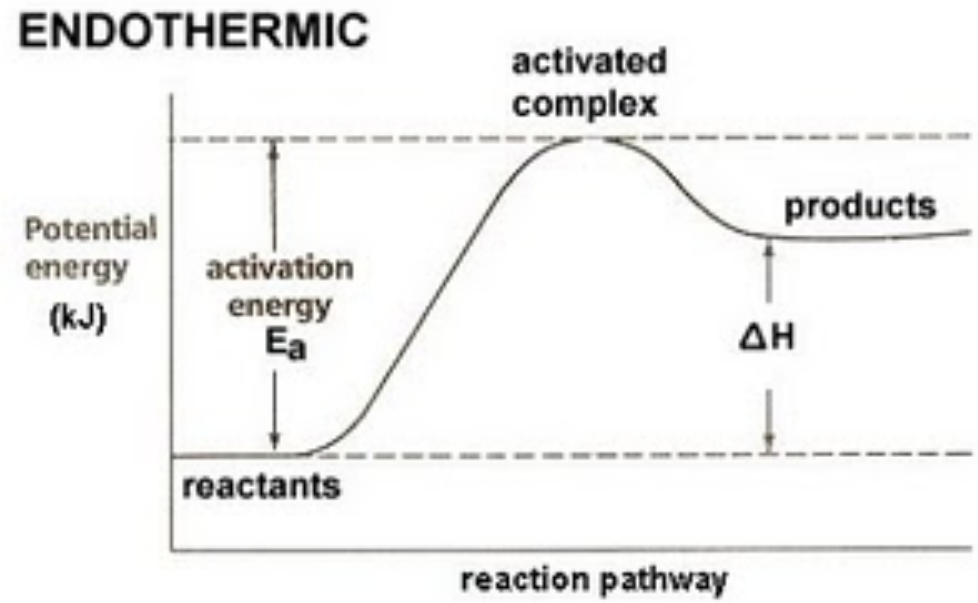




Endothermic Processes

- A reaction in which heat energy is absorbed by the system from the surroundings is endothermic.
- Energy IN > Energy OUT





EXAMPLES AND CLUES

	Endothermic	Exothermic
Description	absorb energy	release energy in the form of light, heat, or sound
Clues	growing, melting, boiling, cooking, makes surroundings colder	burning, exploding, freezing, condensing, sound released, makes surroundings warmer
Examples	water boiling, person sweating, ice melting	firecracker exploding, volcano erupting, making ice cubes

Endo – cold pack ------ exo – hand warmers

Temperature of a Reaction

- Temperature relates to the average kinetic energy of the atoms in the material

- In exothermic reactions the temperature of the surroundings increase

- In endothermic reactions the temperature of the surroundings decreases

Heat of a Reaction

-Heat is the transfer of energy

From high energy to low energy

From Warm to Cold

This results in a change in the kinetic energy of particles --- this causes a change in the temperature of the system

Thermal Energy --

-Generated and measured by heat

-Refers to the internal energy of a system which is the total present kinetic energy resulting from the random movements of atoms